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TELECOMMUNICATIONS R&D

A Look at the Xichang Satellite Launch Complex

90CF0167 Chengdu SICHUAN RIBAO in Chinese
13 Oct 89 p 2

[Article by Zhang Liquan [1728 0448 3123]]

[Text] In late October 1988, the weather in Xichang was still sunny and mild, and the landscape still retained its green color. Reporters and their spouses from 18 different countries converged on this somewhat mysterious city to visit one of China's satellite launch complexes.

They were surprised and excited to have the opportunity to tour this complex, but they also had many questions on their minds:

"How reliable are China's satellite launch services?"

"How can the secrets of satellite technologies of foreign users be protected?"

"Would the low cost of China's launch services pose a threat to the international aerospace industry?"

In actuality, China had already signed contracts with many foreign users to launch their satellites from the Xichang Launch Complex. The purpose of inviting foreign reporters to visit the launch center was primarily to answer some of these questions which were of great concern to the Western world.

During this tour, the visitors first arrived at the enormous rocket test facility, where they saw the 40-meter-long Long March 3 rocket and the sophisticated test equipment. They were highly impressed by this world-class facility.

Then they came to the command and control center, where on a large TV screen they saw video replays of exciting scenes of rockets lifting off the launch pad to carry China's communications satellites into space.

At the launch tower, the visitors ascended to the top, where they could see the surrounding mountain ranges, the green forests and the endless blue sky. This is truly an ideal launch site.

Arriving at the Xichang ground station, they were given the opportunity to closely examine the Chinese-built tracking and observation equipment, which can accurately acquire and track small objects in space. They also listened to an oral presentation of an overview of the Xichang Launch Center by one of the officers in charge, and had all their questions answered.

After the visit, the chief correspondent of the United Press in Beijing, Mr Eberlin, filed this report: "China's Xichang Launch Center and its 11-story launch tower can no longer be ignored by the aerospace community around the world; these facilities show that China definitely has a place in the international satellite launch market."

A short time after the visit, at 20 hours 40 minutes on 22 December 1988, the Xichang Launch Center successfully launched another operational communications satellite. This represented a turning point in China's satellite communications industry as its satellites advanced from the experimental stage to the operational stage, and [signaled that] the current status of leasing foreign communications satellites would soon come to an end.

During the latest launch, China had invited for the first time government and industry representatives from the United States, France, West Germany, Pakistan, Iran, Australia, and Brazil to fly from Beijing to Xichang to tour the launch facilities and to witness the launch event.

Because of the increase in satellite weight from 900 kg to more than 1000 kg, it was difficult to predict how the Long March 3 rocket would perform with the increased payload.

On the day of the launch, the weather was abnormal and unpredictable; from one moment to the next, it would change from clear blue sky to heavy overcast. Fearing that adverse weather conditions might postpone the launch or cause launch failures, the site meteorologists and the launch commander were greatly concerned.

By evening, just before entering the optimum launch window, the sky fortunately cleared up and everyone's spirit soared. At 20 hours 10 minutes, the underground command and control center issued a command: "launch minus 30 minutes." At 20 hours 40 minutes, the commander pushed the ignition button, and the rocket roared to life, ejecting a powerful stream of orange-colored flame which lit up the night sky. Then the rocket lifted off the ground, with a long bright "tail" trailing behind, and ascended rapidly toward the southeast along a designated trajectory.

Twenty minutes later, a message was received from the Weinan tracking and control center: the satellite had entered an elliptical orbit around the earth. The launch was a success! This was the fifth successful launch from the Xichang Launch Center since January 1984. After witnessing the launch, the foreign visitors were totally convinced that China is well equipped to launch foreign satellites.

In June 1970, it was Premier Zhou Enlai who, after reviewing many expert opinions and contemplating the pros and cons of different options, decided to build the launch complex in this valley.

Xichang is located at 102° E. longitude and 28° N. latitude; from the point of view of launch environment and safety considerations, this is an ideal location for a launch site. Its elevation is 1500 meters above sea level, and its climate is mild all year around, with 320 days of sunshine per year. Because of its low geographic latitude, significant savings in rocket propellant can be realized by taking advantage of the larger centrifugal force from earth's rotation; it is also easier to inject a satellite into geosynchronous orbit.

However, building the launch complex was a struggle. During the "10-year turmoil" period, many construction materials were in short supply; as a result, the construction project was often in a semi-halted state.

In the spring of 1975, as head of the State Council, Comrade Deng Xiaoping drafted a systems engineering plan to build our own communications satellites and submitted the plan to Chairman Mao and Premier Zhou. On 31 March, the plan was officially approved by the Party Central Committee. This decision by the state provided a strong motivation for mobilizing the work force, and the project moved forward at full speed. Waves of construction engineers and workers began to arrive at Xichang. They unselfishly contributed their labor and sweat; some even sacrificed their lives. By mid 1980, the Xichang Satellite Launch Complex, which cost the state several hundred million yuan, began to take shape.

Shortly after the 3d Plenary Session of the 11th CPC Central Committee, China underwent major political changes and economic reforms; the improved economic conditions which resulted from the changes provided a good opportunity for bringing the Xichang Launch Center into operation. By the summer of 1983, all the subsystems of the Launch Center were completed and integrated; this large satellite launch complex finally was ready for operation.

On 10 October 1986, the then U.S. Secretary of Defense Casper Weinberger arrived from Beijing in a state-provided airplane. This was the first time a foreign official ever visited the Xichang Satellite Launch Complex. He was given a briefing on materials that previously had been classified top secret. In the afternoon, after an automobile tour of several of the major facilities, Weinberger made the following comments to the accompanying Chinese and foreign reporters: "There is no doubt in my mind that this center has the capability to launch satellites; it also has great potential for future space activities. Many of the facilities are currently being improved to carry out China's own space programs and to launch (foreign) commercial satellites. I am very impressed by what I saw."

The Xichang Launch Center had also received many other foreign space experts and government officials to solicit their opinions and suggestions. In particular, an official of the French National Center for Space Research [CNES], Mr (Wei-nie-er) Loire, compared the Ariane Rocket Launch Center with the Xichang Launch Center. He said: "In terms of facilities, launch procedures, and launch capabilities, I believe the Xichang Launch Center has the same standards as the Guyana Launch Center."

The Kennedy Space Center is the most advanced and largest launch complex in the world; its director, Mr Smith, was among the visitors at the Xichang Launch Center. He said: "I am surprised that China has such a modern command and control center, and most of the equipment has been built by Chinese engineers; I am also surprised to find that China's aerospace industry has reached a level comparable to that of the United States during the 1970's when they launched the Apollo spacecraft."

Another visitor was the Technical Director of the Houston Space Center, Mr Rosen, who is nicknamed the "Father of Artificial Satellites." As he and his colleagues entered the launch command building, he made a "thumbs-up" sign and exclaimed: "Houston! Xichang!" He carefully examined all the facilities at the launch center and asked the host many questions. After the tour, he said: "We have no doubt that China has the technology to launch Western satellites."

While foreign visitors were coming to the Xichang Launch Center by the dozens, Chinese commanders and scientific experts were also sent to the United States, France and other countries to visit their space facilities and to learn from their experience. These exchanges have enabled us to better evaluate our own technical capabilities and space facilities. Based on the opinions of the returning Chinese experts, an important policy was formed: The Xichang Launch Center must open its doors and try to enter the international market of launching foreign commercial satellites. In April 1988, the director of the Xichang Launch Center, General Hou Fu made an announcement in a newspaper: "We have a strong contingent of engineers and technicians, and world-class facilities; we also have state-of-the-art launch technologies and reliable launch vehicles. We are confident that we can put various types of satellites into orbit."

Since 1987, many interested foreign government and industry representatives have contacted us to discuss launching commercial satellites using Chinese launch vehicles and Chinese launch sites. Some have already signed contracts with the China Great Wall Industry Corporation to launch satellites from the Xichang Launch Center.

To further develop China's aerospace technology and to expand China's market share in the satellite launch business, the Chinese Government decided in August 1987 to initiate an effort to make improvements to the grounds and facilities of the Xichang Satellite Launch Complex, and to begin construction of new facilities that were urgently needed.

Thousands of engineers and technicians arrived in Xichang from Beijing, Chengdu and Xian to set up new construction sites at the Launch Center.

Every morning, a special team of workers wearing protective helmets ascended the 76-meter launch tower in an elevator. Working on the mobile platform, they installed protective equipment and new components, and made repairs to pipes and cables. After several months of continuous labor, the effective payload of the launch tower was increased so that it could now launch a 1.5-ton satellite to any designated location in space.

Next to the test facility, a new 6134m^2 x 25m satellite inspection room was built. The construction project was contracted to the Jiansi Company and the Industrial Installation Company of Chengdu City, and was completed in approximately 140 days. This inspection room was designed and built specially to accommodate foreign satellites; it was built to very high technical standards, with special requirements on cleanliness. Inside the building there were marble floors, steel-reinforced glass doors and windows, and interior rooms which were completely secured. The foreign experts who inspected the building rated the engineering quality of the building as excellent.

From the edge of Xichang City, one can see the newly constructed satellite communications ground station. The station has two dish antennas which can be used to transmit or receive images or data to and from the satellite and to perform the tracking and control functions. There are two sets of advanced communications equipment, one built in this country and one imported, that are used alternately to transmit information about the satellite to any part of the world.

Other renovations and new construction projects at the Launch Center include the X-ray satellite inspection room, the apogee engine room, the high-voltage and low-voltage power distribution room, and a lodge for foreign visitors. All these high-quality installations were completed within one year's time.

Launching a geosynchronous communications satellite is a large and complex systems engineering effort. The Chinese Government is ready to provide the support and cooperation of many other organizations and government agencies to ensure its success.

The facts presented in this article send a clear message to the world: China will become a strong member in the international aerospace community.

Anti-Liver-Cancer Immunotoxin Produced

90CF0139A Shanghai WEN HUI BAO in Chinese 8 Oct 89 p 1

[Text] Major gains have been made in research into the use of immunotoxins to treat liver cancer. The Immunotoxin Research Group of the Chinese Academy of Sciences' Shanghai Institute of Biochemistry in close cooperation with the Shanghai Cytology Institute's liver-cancer monoclonal-antibody research group utilized trichosanthin [i.e., Radix Trichosanthis protein] and monoclonal antibodies in conjunction to prepare an immunotoxin capable of combating human liver cancer. Recent animal experiments indicate this kind of immunotoxin can check the growth of liver tumors.

Malignant tumors are a frightening enemy of modern man. Today, the greatest problem is how to obtain a directional drug which is highly effective in killing cancer cells while harming normal cells very little. Since the 1975 discovery by an English scientist of the technique of using hybrid tumors to produce monoclonal antibodies, commonly called "biological guided missiles," research and development of this type of directional drug has become possible.

Through a long period of rigorous work, both domestic and foreign scientists have isolated a number of monoclonal antibodies very highly specific to certain tumors. Major progress has also been made in basic research on immunotoxins and in research into techniques of preparing immunotoxins.

At the end of 1985, Assistant Researcher Xie Hong [6200 1738] and others of the Shanghai Cytology Institute isolated a monoclonal antibody highly effective in recognizing liver cancer and successful against liver cancer in a patient's body. Simultaneously, Assistant Researcher Wang Qingcheng [3769 1987 6134] and others of the Shanghai Institute of Biochemistry, after investigating the use of ricin and abrin [i.e., jequirity-bean toxic protein] in the preparation of immunotoxins, shifted to carrying out trichosanthin immunotoxin research.

Trichosanthin is a type of protein in the root section of gualou, a plant peculiar to China. China's scientists have basically elucidated its structure and have discovered that it is very similar to the often-used immunotoxic "warhead" ricin A chain. Presently, these are the only two types of 3-dimensional-structure protein used in this kind of protein research. Clinically, they have been used in large amounts to prevent early-term and mid-term-pregnancy delivery, and are particularly effective against malignant moles and tubular pregnancy. Wang Qingcheng and others have verified that trichosanthin can completely replace ricin A chain in the making of an immunotoxin. Moreover, better in vivo results can be obtained. Recently, an article published in the Journal of the American Academy of Sciences stated that it is also possibly effective against AIDS, dreaded by the people of today; this has further evoked the interest of scientists.

Beginning in the latter half of last year, Wang Qingcheng, Xie Hong and other scientists began using the new-generation trichosanthin immunotoxin to carry out treatment tests on naked mice with transplanted human liver cancer. In a recent experiment, after waiting for the liver cancer to grow in the infected mice for 2 weeks, six were injected with immunotoxin and the other infected mice were injected with physiological saline solution only. The experiment's results were exciting. The tumors in three mice of the treated group vanished. In another, the tumors only increased a small amount and their health conditions were excellent, while tumors of several grams grew in all the mice of the control group.

As is known, obtaining such obvious anti-cancer results using relatively low dosages as those of an immunotoxin is not only very difficult to achieve with conventional anti-cancer drugs but is also not often seen, even among foreign immunotoxin research results which have been reported.

Wang Qingcheng told the reporter: "I hope to enter clinical testing as soon as possible; however, a great deal of pre-clinical testing must still be done to verify its feasibility."

Liver-Cancer-Causing Protooncogenes Discovered

90CF0139C Beijing GUANGMING RIBAO in Chinese 22 Oct 89 p 1

[Text] Shanghai, 21 Oct 89 (XINHUA)—Shanghai Tumor Institute Researcher Gu Jianren [7357 0256 0086] and the key national oncogene and interrelated gene laboratory he leads, after many years of investigation, have confirmed for the first time internationally that there are at least seven protooncogenes which play a role in human liver-cancer formation.

These seven protooncogenes and interrelated genes are: N-ras, C-myc, C-fms, C-ets$_2$, C-fos, P^{53}, and IGF-II. The participation of the above oncogenes comprises the characteristic "oncogene spectrum" of human liver cancer.

Further research has revealed that the above seven protooncogenes and interrelated genes can be divided into roughly four types. One is the N-ras gene, possibly related to signal transmission. A second type is the C-myc, C-ets$_2$, C-fos, and P^{53} genes, related to initiation of liver-cell caryokinesis. The third type is the IGF-II gene, which is the growth factor produced by the liver-cancer cells themselves. The fourth type is the C-fms gene, which is part of the growth-factor acceptor.

In 1985, Gu Jianren and his key national oncogene and interrelated gene laboratory, which at the time was still being constructed, confirmed internationally for the first time that the N-ras gene is a carcinogenic gene for human primary liver cancer. Thereafter, systematic research into protooncogene expression was done on

human primary liver cancer and on cancerous tissues adjacent to the liver. Ultimately, the above conclusion was obtained.

Many kinds of oncogene are involved in the cancerous transformation of a tumor. This new discovery has provided the basis for furthering research into blocking gene expression and other means of controlling the growth of cancerous cells.

Since the establishment of the Shanghai Tumor Research Institute in 1958, the 58-year-old Gu Jianren has continuously been engaged in research work at this institute. Because of his outstanding contributions in the area of cancer science research, he has been judged to be "a scientist who has made contributions on a national level."

Cellular Strains of Chinese HLA System

90CF0139B Shanghai WEN HUI BAO in Chinese 14 Oct 89 p 1

[Text] The world's first DW homozygous-type cellular strains from a Chinese human leukocyte antigen (HLA) system have been established, opening up new prospects for the utilization of biochemical and molecular biology techniques to study Chinese HLA system structure and function. This is the good news spread at the Chinese HLA system DW research appraisal conference held at the Shanghai Municipal Immunology Research Institute (SMII) yesterday.

The specialist appraisal committee composed of well-known immunologists, member of the academic committee of the Chinese Academy of Sciences, Shanghai Cytology Institute's Professor Yao Zhen [1202 3791] and human geneticists, Fudan University Genetics Research Institute's Professor Liu Zudong [0491 4371 3159] and others considered that the success of this research project has vaulted China from this research carried out on a cytological level into the front ranks worldwide. This achievement has filled a void in this country and meets advanced international standards.

The HLA system is involved in the regulation and control of the organism's immune response capability to the outside environment. The structure and function of this system and its connection with clinical medicine has been, over the past several years, one of the most active fields in basic medical and overall life-science research. In 1982, when the Ministry of Health directed the formulation of a national leukocyte typing program, SMII was designated to take responsibility for this major task. The HLA comes separately from the genetic information of the mother and father. Moreover, the cells used in DW typing must carry similar genetic factors (homozygotes) from the mother and father in order to work. After 6 years of effort, Assistant Director of SMII, Assistant Researcher Zhou Guangyan [0719 0342 3508], Assistant Laboratory Director Lu Peihua [7120 0160 5478], and Assistant Professor Zheng Zexian [6774 3419 6897] of the Shanghai Number Two Medical College, along with other medical technicians screened out 14 Chinese HLA system homozygotes from over 400 Shanghai Municipality families in which close relatives were married and used them to cultivate cellular strains. Molecular biology techniques were used to directly analyze the genetic structure of four of these cellular strains. It was discovered that they belong to three new varieties of the DW subtype which, at present, have not yet been recognized anywhere in the world. Part of the cellular strains' particular reaction pattern has already been confirmed by nine prominent international HLA laboratories in Japan, Austria, the United States, Britain, and other countries.

The initial success of this task was in providing material for experiments which have Chinese specificity. This is of major guiding significance for the clarification of the Chinese leukocyte DW antigen situation, for research into the relationship between the HLA system and disease, and for disease diagnosis and treatment.

Key S&T Project: Protein Conformation Study

90CF0139D Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 25 Oct 89 p 3

[Text] The study of the relationship between protein structure and function has always been a major topic in the fields of biochemistry and molecular biology. The most important characteristic of the structure of a protein molecule is that it not only has a specific chemical structure, but also a particular spatial structure, i.e., its conformation. The function of a protein is closely related to its specific conformation; moreover, often accompanying the process of a protein's functional expression is a process of dynamic change in its conformation. The environment within biological organisms in which protein function is expressed is a solution under physiological PH conditions. Therefore research into protein conformation and conformational change under solution conditions is critical to elucidating the relationship between protein structure and function.

Using natural metaproteins as models to study conformation assembly—in the past, purely theoretical research—has become a topic with important practical significance, because this kind of metaprotein is a very good model of the products of genetic engineering. Finding appropriate conditions to make the assembled conformation and the natural conformation identical will be an important step in the aftertreatment process following the expression of recombined genes. The design of functional proteins and polypeptide molecules through organic synthesis or genetic-engineering methods according to the needs of mankind is the primary substance of protein engineering. For this kind of design, knowledge of protein conformation is a prerequisite. Therefore, the study of protein conformation will provide an experimental foundation for molecular design.

The guiding concept of this project is the study of the relationship between protein conformation and function, and the process of conformational assembly. An extremely important part of this is the dynamic conformation of proteins. The research objectives are: One, as regards the study of conformation and conformational dynamics, to explore the relationship between conformation and function so as to provide the theoretical basis for the design of peptides and new protein molecules. Two, as regards the study of conformational assembly, to explore the mechanics of conformation formation and the principles of protein stability in order to provide a design basis for the study of the aftertreatment of each type of protein in the bioengineering process—the process of converting initial products into biologically active proteins. In order to realize the above objectives, this project has been designed to initiate research from the point of intersection of two areas. One area is the selection of three types of protein of different molecular size levels as objects of study (or models). This is to facilitate the induction of sufficiently representative principles. The other area is the utilization of diverse techniques for the study of the conformation of proteins in solution, which is beneficial to a comprehensive elucidation of conformation and its changes.

The anticipated results of this project are: 1) The use of an integration of two-dimensional nuclear magnetic resonance and other methods to interpret the complete conformation of several large peptides and one small protein. 2) The proposal of a more complete theory of protein conformation assembly, including the nascent conformation of proteins, the conformational nucleus theory of the conformational assembly process and the theory of a conformational nucleus forming natural conformation. Also, the proposal of a theory of the relationship between all levels of conformation in the conformation construction process and function. 3) A description, centered on several specific proteins, of their conformational assembly, the functional generation process and dynamic changes in conformation.

Those responsible for this research task include: Researchers Lu Zixian and Xu Genjun of the Chinese Academy of Sciences' (CAS) Shanghai Institute of Biology, Researcher Zou Chenglu and Assistant Researcher Zhou Yunmei of CAS' Institute of Biophysics, and Assistant Researcher Shi Yunyu of the University of Science and Technology of China. The project director is Researcher Lu Zixian [7267 1311 6343].

New Bactericidal Drug Produced

90CF0139E Beijing RENMIN RIBAO in Chinese 7 Nov 89 p 1

[Text] Wuhan, 6 Nov (XINHUA)—A new breakthrough has been obtained in China's research and development of bactericidal drugs. A new kind of orally taken, highly effective bactericidal drug with broad effectiveness in treating all varieties of human body infection passed appraisal during the latter part of October in Wuhan. Concerned specialists feel that this type of drug could, by the end of this century, replace the older generation of bactericidal drugs and become a major anti-infection drug in clinical applications.

This new drug which the Ministry of Health has named yi-nuo-sha-xing [0181 6179 3097 2502 ?inosasine], also called fu-ding-suan [8636 0570 6808 ?fluorodine acid], belongs to the country's second class of new drugs and was the product of successful development by the Wuhan Pharmaceuticals Plant and the Biotechnology Research Institute of the Chinese Academy of Medical Sciences. In 1986, the Wuhan Pharmaceuticals Plant broke with traditional techniques for manufacturing bactericidal drugs and utilized pills and capsules synthesized by chemical methods. In clinical application by seven large hospitals nationwide, e.g., PLA Hospital Number 302, the Beijing Cooperative Hospital and the Hubei Provincial People's Hospital, an overall rate of effectiveness of greater than 95 percent was achieved in the treatment of infections of the human digestive system, respiratory system and urinary-genital system. Its rate of effectiveness in treating two types of infectious typhoid and biliary-tract disease, skin diseases, soft-tissue disease and many other infectious chronic diseases is close to 100 percent.

Clinical study also indicates that this oral preparation has a higher rate of elimination of inflammatory bacteria than other antibiotic drugs. Shanghai's Huashan Hospital Antibiotics Research Institute and the Shanghai Institute for the Prevention of Skin Disease tested this oral preparation against gonorrhea. The 23 afflicted people who received treatment were cured after only one course.

At the appraisal conference, the concerned specialists considered this new drug to be clearly superior to the ampicillin, erythromycin, chloramphenicol and gentamycin antibiotics at present commonly used domestically.

Pharmacodynamics of Dihydroartemisinine Against *Plasmodium Berghei* in Mice

40091005a Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 24 No 7, Jul 89 pp 487-489

[English abstract of article by Li Chengshao [2621 2052 7300], Du Yilan [2629 0110 5695], et al., of the Institute of Traditional Chinese Medicine and Materia Medica of Shandong Province, Jinan]

[Text] Dihydroartemisinine (DHA) is a derivative of qinghaosu (artemisinine), which is an antimalarial drug. DHA was given to mice inoculated with *Plasmodium berghei* ANKA strain by intramuscular [im]injection. Within the proper dosage range, the dose-effect and time-effect curves of DHA against malaria can be described by $y = 4.9960 + 2.9536x$ and $y = 7.2654 - 0.3414t$, respectively, where y is the estimated value of the parasitemia suppression rate in probit, x is the log

dose, and t is the period since the im drug administration. Accordingly, ED_{50} = 1.00 +/- 0.13 mg/kg, and the time of half-effect was 6.6 hours when the dose was 5.0 mg/kg im. The elimination rate constant of the effective dose *in vivo* was 0.2662 h^{-1}, with a half-life of 2.6 hours.

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Synthesis of Antiviral Agents Acyclic Nucleosides of 4-Substituted Pyrrolo [2, 3-d] Pyrimidine

40091005b Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 24 No 7, Jul 89 pp 496-501

[English abstract of article by Jiang Xiangjun [5592 3276 0689], Zhou Li [0719 4539], et al., of the Institute of Medicinal Biotechnology, Chinese Academy of Medical Sciences, Beijing]

[Text] The naturally-occurring nucleosides of pyrrolo [2, 3-d] pyrimidine, tubercidin, sangivamycin and toyocamycin have been recognized as antibiotics not only for their potent antitumor activity, but also for their significant antiviral effects. However, none of them has been developed as a useful drug due to the high toxicity involved. In order to reduce the toxicity of this kind of compound and reveal the relationship between structure and biological activity, a series of acyclic analogues of tubercidin with varied 4-substituted amino groups was synthesized. 4-chlor-pyrrolo (2, 3-d) pyrimidin was used as the starting material which, reacting with 1, 3-dibenzyloxy-glycerol-2-chloro-methylether by the direct sodium salt glycosylation procedure, provided the key intermediate (IX). After hydrogenation, amination of compound IX provided the final free hydroxy products. All compounds were tested *in vitro* against HSV-1 and Cox B6. Only three of them (XI_6, XI_7, XI_9) exhibited certain activity against Cox B6.

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Synthesis, Antimalarial, Antineoplastic Activities of Some Derivatives of 2, 4-Diamino-5-Methyl-6-Substituted Benzylaminoquinazolines

40091005c Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 24 No 8, Aug 89 pp 578-586

[English abstract of article by Meng Xiaoying [5536 1420 5391], Zhang Xiuping [1728 4423 1627], et al., of Shanghai Institute of Pharmaceutical Industry; Li Gaode [2621 7559 1795] of the Second Military College, Shanghai]

[Text] This paper reports the synthesis and the antimalarial and anticancer activities of some derivatives of 2, 4-diamino-5-methyl-6-substituted benzylaminoquinazolines. These compounds were synthesized by the condensation of 5-methyl-2, 4, 6-triaminoquinazoline with substituted benzylaldehyde, producing a Schiff base, followed by reduction, formylation or nitrosation. The suppressive therapeutic effects against *Plasmodium*

berghei in mice demonstrated that the suppressive rate of three compounds ($IV_{2,5,6}$) was 100 percent at the dosage of 5 mg/kg. The anticancer activity *in vitro showed that* II_7 *and* IV_8 *had the strongest inhibition, and their* IC_{50} *against the L1210 leukemia cell was* 3.910×10^{-3} *g/ml and* 6.172×10^{-3} *g/ml, respectively.*

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Engineering Software Package Developed

40100022C Beijing CHINA DAILY (Business Weekly) in English 8 Jan 90 p 4

[Text] Chinese scientists have succeeded in developing the country's first complete engineering software package.

The large-scale software kit was developed by researchers at the Institute of Software of the Chinese Academy of Sciences.

The package, called a "requirement specification language-requirement specification analyzer," is one of the key research projects of the Seventh Five-Year Plan Period (1986-90).

The package, composed of a special language, an analysis system, a supporting environment and a data base, will be applied in missiles, aviation and space flight, oil exploration, mail and telecommunications, industrial construction and urban planning.

Computer experts believe that the software package, which equals the sophistication of foreign systems of the mid-1980s, provides an automated tool for software development in China.

It will replace the current manual-design software, improving the quality and efficiency of designs in engineering projects. It will also save a large amount of manpower, material, and money.

The State Commission of Science and Technology recently cited the software package as one of the nation's outstanding technological products of 1989.

In another development, the WORKERS DAILY reported that a Beijing television manufacturing plant has developed a 54-centimetre flat screen for computers. It is the first of its kind in China.

New Military Automation Software Unveiled

Engineers' Systems Command Software

90CF0081 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 36, 20 Sep 89 p 1

[Article by Tan Keming [6223 0344 2494]: "Engineering Systems Command Automation Software Development Plan Debuts"]

[Text] The Armed Forces Engineering Systems Command Automation Software Development Plan was discussed on 15 August in Yantai. It is the first long-range plan for the development of military command automation software for China's military to be openly discussed, and it takes a gratifying step toward the goal of moving armed forces command automation software development in the direction of implementing "unified leadership, unified planning, unified organization, and unified standards."

Since 1984, the development effort for the Armed Forces Engineering Systems Command Automation Software has achieved great progress under the organizational leadership of the General Staff Engineering Corps Department. More than 100 items of various application software have been developed, among which are 18 pieces judged to be outstanding software for all forces, and 17 programs judged to be outstanding software for engineering systems. Among the subject matter covered are eight major pieces of high-level intelligent software involving the profession and different levels of strategy, campaigns, tactics, and engineering technology. Functions are developed from simple data management into calculation optimization, quantitative evaluation, operations planning, and decision support. The majority of software has undergone verification involving training, exercises, and actual duty, producing high strategic results with a high application value. But because it lacks unified planning and management, the software that has been developed still has such problems as duplicative development, low-level circulation, and application results that are not high. There has been an urgent need to enhance overall control and guidance, and to improve the level of software development and application. In accordance with this requirement, the General Staff Engineering Corps Department promptly undertook investigative research, and arranged for the formulation of the "Development Plan for Engineering Systems Command Automation Software."

The fundamental principles and theories to be complied with, according to the plan's proposal for software development efforts, are: the principles that call for implementation of a good foundation, smooth interaction of relations, consolidation of successes, and improvement of results; enhancement of efforts at fundamental preparations for software development; and attention paid to making the most of the results of existing software. Efforts should be made to resolutely establish an engineering systems command automation software system on the basis of armed forces unified leadership, unified planning, unified structure, and unified standards. There should be a resolute integration of combat with training, joint principles for command management, and progressive improvement of the standards for automation of engineering systems information handling and for making command decision-support scientific. The most should be made of the enthusiasm of the different levels of engineering organizations, units, institutions, and research units for rationally dividing labor, closely cooperating, and developing in coordination. And there should be detailed planning regarding such problems as the system structure of the engineering systems software, development goals, development steps, division of task labor, and funding sources. As discussed by the conference specialists, the plan meets the needs of development efforts of armed forces command automation software. This is a groundbreaking effort, and will not only have great significance toward improving the engineering systems command automation software development and application, but will also serve an important role in

stimulating as quickly as possible the serialization, the standardization, and universality of armed forces command automation software.

Automated Command Network Expanded

90CF0081 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 37, 27 Sep 89 p 2

[Article by Liang Songlin [2733 2646 2651] and Zhou Fugui [0719 4395 6311]: "Successful Test Hook-up of Tibet Military Region With Armed Forces Command Automation Network"]

[Text] On the eve of the National Day celebration, the following news report was issued from the Tibet Military Region: A test connection was made between a terminal on the armed forces command automation network and this military region's command automation network, and with this action we enter an era of command automation, which signifies the completion of a command automation network for all armed forces units of the army level and higher.

From successful on-line connection on 25 July to the present, the Tibet Military Region has transmitted 50 telegraphic dispatches and 30 images, all of which arrived with satisfactory results regarding accuracy, punctuality, security, and clarity.

The Tibet Military Region command automation network is a portion of the armed forces command automation network for units of the army level and higher. But because of the harsh climate of the Tibet Plateau, transmission channels are difficult, to which must be added a weak technical capability; all of this has created difficulties for this major project that would have been difficult to imagine. Some experts once predicted that it would be difficult to put the Tibet Military Region command automation on-line with the other armed forces, but pertinent departments of the Chengdu Military Region and the Tibet Military Region rose to the challenge. Early this year [1989], carefully chosen personnel from the Tibet Military Region went into the interior for training, and the Chengdu Military Region promptly sent specialist technical personnel into Tibet for repeated experiments. With the close, strong support of relevant units both within and outside the region, they quickly resolved the technical difficulties involving the time delay of satellite communications and the conversion interface between wired channels and radio channels, until finally on 25 July communications were achieved with Chengdu nodes of the armed forces command automation network.

The establishment of the Tibet Military Region command automation transmission and processing system improves the office efficiency of units stationed in Tibet, reduces the time for transmission of electronic text and images, and realizes command automation for the General Staff Headquarters and the Chengdu Military Region with respect to the Tibet Military Region. Today, the Tibet Military Region can automatically transmit and exchange official documents, files, data, and static images, and share data [and graphics] with any army-level unit throughout the armed forces.

Computer Firm Becomes First Taiwan Sole Proprietorship Established in Beijing

90CF0083C Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 37, 27 Sep 89 p 1

[Article by Xiao Yan [2556 3601]: "The Beijing [Taiwan] Straits Data Company, Ltd. Holds a Mid-Autumn Joint Conference"]

[Text] Coincident with the Mid-Autumn Festival, the first Taiwan wholly-owned enterprise in Beijing—the Beijing Straits Data Company, Ltd.—held a [Taiwan] Straits Conference of Earnest Discussions Between the Two Shores, at which meeting the prosperity of China was espoused and friendly feelings of unity and solidarity within the homeland were promoted.

Nearly 20 artists and calligraphers from both sides of the Straits, invited by the host side, attended the meeting, and did impromptu drawings and calligraphy on behalf of the 11th Asian Games, at which time, the Data Company announced that in addition to taking on data processing as an aid to the Asian Games, the Straits Data Company, Ltd. would contribute high scientific and technological products to the Asian Games Fund-Raising Committee, as for example, a Chinese-character expansion card that does both simplified and regular characters.

Novell Fault-Tolerant Netware V2.15 Sinicized

90CF0083E Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 38, 4 Oct 89 p 1

[Article by Huang Ji [7806 0370]: "Successful Development of Novell's Version 2.15 Network Adapted for Chinese Characters and With Fault-Tolerant Functions"]

[Text] The Beijing Lanshen [5663 3234] Computer Network System Company (under the Commission of Science, Technology, and Industry for National Defense), which has taken the lead domestically in developing 3+ networks, recently finished its Chinese-character development work on the American Novell Company's SFT [System Fault Tolerant] NetWare V2.15, the version 2.0A of which software had been ranked highest in an international network evaluation in 1988. Aside from having the sharing and communications functions of general networks, the SFT V2.15 software also has a clear advantage in such areas as speed and conservation of hardware overhead. In particular, its characteristics regarding system fault tolerance, resource security, and user management have no equal among currently available network software.

This company also recently cooperated with the Beijing Jinzhong Electronics Company, Ltd. to develop a Chinese-made version of the ARCNET network hardware system and a low-cost, high-performance network hardware system named Powernet. These two hardware systems passed testing by experts, and were found to completely support the Novell network software in all versions and to have the capability for connecting office-automation networks with industrial automatic-control networks. In these aspects, they were found to be of a high value for dissemination and application, and will play an important role in speeding up the development of China's microcomputer networks.

Tianjin Bureau of Instrumentation Initiates Anti-Computer-Virus Efforts

90CF0083B Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 36, 20 Sep 89 p 2

[Article by Zhang Xiongwei [1728 7160 0251]: "The Tianjin Bureau of Electronic Instrumentation Initiates 'Computer Virus' Survey and Prevention Efforts Within Its System"]

[Text] To thoroughly eliminate the effects and degree of danger brought upon computer users and institutions by "computer viruses," not long ago, the Tianjin Bureau of Electronic Instrumentation complied with the request of the Tianjin Municipality Bureau of Public Security, and has begun efforts toward surveying and preventing computer viruses at more than 20 companies engaged in computer manufacture and applications within the entire bureau system. Particular methods include: requesting each unit to inspect all computers it uses, and especially microcomputers, by means of a software program for detecting instances of the computer virus phenomena that has appeared throughout China; filling out virus survey records, analyzing viruses, arranging for persons using computers to acquire knowledge about computer viruses, studying methods for preventing and eliminating viruses, and establishing relations and exchange information regarding these efforts with departments of public security. Looking at user-survey virus records of this bureau from the first stage, at present, 60 percent and more of microcomputers used by these units have experienced computer viruses, especially among the PC series of microcomputers. The most commonly seen types of virus phenomena are: the display-screen jumping ball, random shifts of the screen cursor, hung [i.e., deadlocked] machines, and loss of data. These viruses prevent normal operation of the computer, lead to loss of large volumes of valuable data, and cause much wasted time for operations personnel.

The Tianjin Bureau of Electronic Instrumentation is a new-technology industry having a complete line of electro-mechanical products with a broad extent of computer applications. The appearance of computer viruses, together with their effect on work, has drawn quite a bit of attention from bureau leadership at all levels. According to the working plan, after this bureau has accomplished the first stage of its virus survey and recording, it will undertake specific efforts at virus prevention and cures in the second stage.

Report on 11 Domestic Computer Networks

90CF0083A Beijing ZHONGGUO DIANZI BAO in Chinese 19 Sep 89 p 1

[Article by Liu Keli [0491 0344 7787]: "Eleven Major Computer Networks Begin To Take Shape"]

[Text] The 11 major computer information communications networks designated in China's Seventh 5-Year Plan as priority projects began to take shape on the eve of China's National Day. The hardware equipment for the networks has for the most part been imported, but the applications software was entirely initiated and developed within China. The 11 major networks constitute a national information lifeline, directing and coordinating the various sectors of the national economy.

—For the wide-ranging posts and telecommunications system, 300-bit-per-second (bps) low-speed data service has been opened throughout the country, with 9600-bps high-speed data transmission in seven cities such as Shenyang and Tianjin.

—A level-4 specialized computer network has been constructed by the national railways on an all-inclusive scale, and more than 400 minicomputers and nearly 10,000 microcomputers make up the network for the Ministry of Railways, 12 railway administrations, and 56 branch offices.

—A level-4 computer economic information system centered on the State Planning Commission links 38 provinces, municipalities, autonomous regions, and cities with provincial-level economic decision-making authority, as well as 85 central cities and 203 counties.

—A level-4 networked electric-power-grid distribution system comprising national scheduling, regional scheduling, provincial-level scheduling, and prefectural scheduling has been formed; already completed are four large automated power-dispatching systems for north, central, east, and northeast China, among which three large power grids are on-line with the national scheduling computer network in a test operation.

In an electronic banking network consisting of counter services, financial information, and funds accounting, counter services have developed most rapidly, and efforts are under way to open a funds accounting system, currently under stepped-up construction, in 36 cities this year.

—A space tracking and control system has been completed; it constitutes a high-to-medium precision monitoring and control network and data-exchange network for satellite testing. This network can facilitate

accurate tracking and control of rockets and satellites over a 9,000-km aerial range up to an altitude of 36,000 kilometers.

—Based on existing short-term weather forecasting with small or medium-size computers, a level-5 national weather-forecasting system has been developed into an intermediate-term weather-forecasting system using supercomputers.

—A civilian airline travel service computerized seat-reservation system connects 20 major cities, and within the year, reservations for international flights will also be handled by this system being developed in China.

—A nationwide science and technology information computer retrieval system is on-line with 10 large information-retrieval systems throughout the world, providing access to 200 million documents.

—Half the provinces and municipalities throughout the country are connected with the Ministry of Public Security, which is a preliminary realization of a key networked social-security-information system that should link up all locations in China by the end of the Seventh 5-Year Plan.

—The late-starting revenue and tax-information system is currently undergoing construction as a level-4 system from the Ministry of Finance down to the county level. In 1989, 11 provinces and municipalities received equipment [for the system], and it estimated that by 1993 the 12 subsystems will be joined into a nationwide network.

Development, Application of Domestic Microcomputer Workstations

90CF0083F Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 38, 4 Oct 89 p 34

[Article by Wu Kezhong [0702 0344 1813] of Institute 6, Ministry of Machine-Building and Electronics Industry: "The Situation Regarding the Development and Application of Microcomputer Workstations in China"]

[Text] **I. China Has Developed Its Own Supermicrocomputer Workstation Systems**

The microcomputer workstation is a new product that appeared abroad during the early 1980's, and that uses a microprocessor to provide the functions of a supermini at relatively low cost. They have suddenly come into their own, and have come to be widely applied in many such fields as CAD/CAM, software engineering, electronic publishing, and artificial intelligence. The 32-bit microcomputer workstations came into being in 1985, the superior performance-to-cost ratio of which has enabled them to gain a large volume of users in the marketplace. This situation naturally affects China's situation, where a number of customers are dissatisfied with the performance of personal computers, but are also unwilling to sustain the cost of superminicomputers, and who have therefore turned their attention in large numbers toward the microcomputer workstations.

In light of this situation, as early as November 1985, management departments in the computer industry of that time acted on the suggestions of experts in determining that China, too, would keep up with the current international 32-bit microcomputer products and develop our own 32-bit general-purpose systems and workstations, and so saying, this priority was included among the key projects of the state's Seventh 5-Year Plan.

In keeping with this decision, beginning in 1986, Institute 6 of the Ministry of Electronics Industry joined together with units from the University of Electronic Science and Technology (formerly Chengdu Institute of Telecommunications Engineering) Microcomputer Institute, Zijin Computers, Tianjin Computer Institute, and Institute 32 of the Ministry of Electronics Industry to form a problem-solving association, responsible for development of a high-performance workstation; and units from such organizations as the Chinese Academy of Sciences (CAS) were responsible for development of a lower-grade workstation. After years of effort, China's independently developed high-performance workstations—the Huasheng 3000 series of supermicrocomputer workstations—easily passed evaluation by experts as arranged by the Ministry of Machine-Building and Electronics Industry at the end of 1988.

This workstation has taken the path of compatibility with prevalent foreign products, using development in stages and concentrated capabilities to put through Chinese-character capability for the basic system and for software beginning with the kernel, and developing hardware to implement the technical strategy of component-level compatibility, which has allowed the entire development of the workstation to be successful.

II. Performance of the Huasheng 3000 Series Workstations

The Huasheng 3000 series of super workstations went into batch production this year. This series consists of two grades, the Huasheng 3160 color and the Huasheng 3100 black and white. Primary performance specifications of the system are as follows:

Hardware

—MC68020 CPU and MC68881 floating-point processor. Master clock frequency is 16.67 MHz, with a computational processing capability of 2 MIPS [million instructions per second].

—4 megabytes of RAM (expandable to 16 megabytes).

—Two RS-232 serial ports (expandable to 16).

—Ethernet network interface, connectable to PCs, Great Wall computers, VAX computers, and Taiji computers.

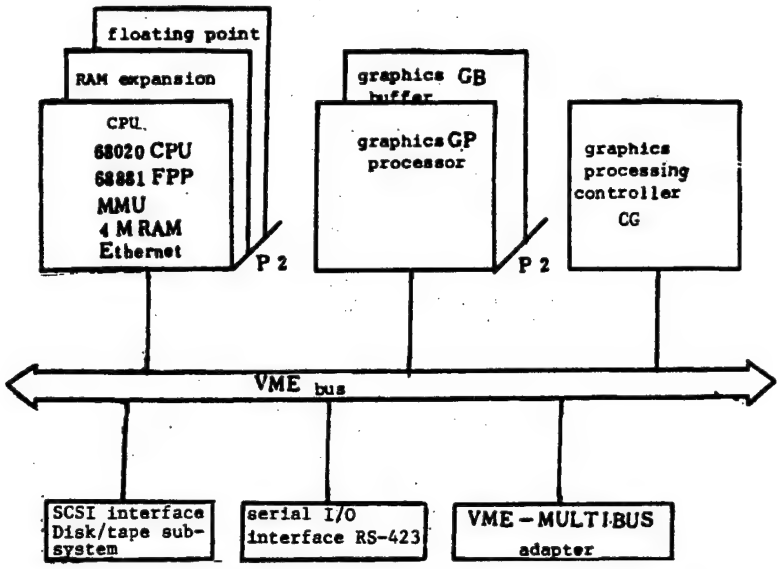

Figure 1. System Structure of the Huasheng 3000 Series Workstation

—Color graphics card, high-resolution color/ monochrome display, keyboard, mouse, 1152X900 resolution, and 256 colors per screen from a palette of 16 million.

—SCSI magnetic-storage equipment interface, to which may be connected one 1/4-inch cartridge tape drive and two 5.25-inch Winchester disk drives: 141 megabytes, two of 141 megabytes, 327 megabytes, and two at 327 megabytes (formatted).

—VME bus motherboard, with 12 expansion slots.

Figure 1 shows the system construction of the Huasheng 3000 series workstations.

Software

Software for the Huasheng 3000 workstations is software compatible with Chinese and Western language text and based on the Unix operating system, and it includes such things as high-level languages, graphics, windows, databases, and networking. The national standard GB2 character base is used for Chinese characters, with three input methods, complete with Chinese-character windows and menus, and Chinese-character input prompt windows with vector Chinese characters. The levels of software are as shown in Figure 2. In addition, there is CCAUTOCAD, system test software, and component test software.

Design of the Huasheng 3000 series workstation was done under the premise of its being compatible with the Sun 3/100. The insertion board is fabricated with a sheet structure, and special devices and PALs [programmable array logic devices] were made by decoding and disassembly. Introducing Chinese characters to the software began with the kernel, using two-byte Chinese-character coding with the high bit as "1"; and high-level language, graphics, window, network, and database software all underwent Chinese-character transformation. Custom installation and incorporation of Chinese characters was done on the workstation for the international standard windows system: X-Windows.

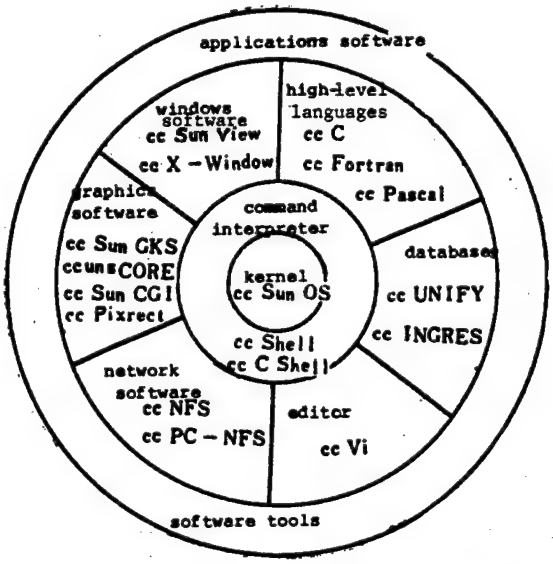

Figure 2. Software Levels for the Huasheng 3000 Series Workstations

Graphics Components

Graphics components for the Huasheng 3000 series workstations were built on the raster graphics base. "Raster graphics" means that each visible pixel in the screen buffer has a corresponding memory cell. Raster

graphics are quite flexible for any desired display purpose, including display of symbols, foreign-language letters, mathematical symbols, straight lines, curves, shading, and photographic images, all at any width.

The display raster is stored in a special area of RAM, which is called the screen buffer or video RAM. The structure of the screen buffer includes graphic elements and pixels. In monochrome mode, the graphic elements are used, which map each bit in RAM to a pixel. In color mode, the pixel format is used, where each byte in RAM is mapped to a pixel in the display.

Resolution of the Huasheng 3000 workstation is 1152X900 pixels, using a 19" high-resolution display monitor. Non-interlaced refresh is done 66 times per second, which is the minimum refresh rate required for a non-flickering display to avoid operator fatigue.

The graphics processor board (GP) and the graphics buffer RAM board (GB) can improve the performance of the graphics processor 2-250 times. Running application programs that use a graphics library (as for example Core, CGI, and GKS), the graphics processor can speed up the formation of images.

Network Functions

The Huasheng 3000 workstation has powerful network functions, which are based upon the TCP/IP [Transmission Control Protocol/Internet Protocol] network protocol. At the same time, consideration has been made for current users of IBM's Binary Synchronous Communications (BSC) and SNA [Systems Network Architecture] communications protocols, as well as the X.25 procedure, which allows connection with Ethernet and other host machines, as well as with remote networks. This was done through the Sunlink software package and the companion [Sun] Communications Processor (SCP) board. The Sunlink software currently includes SNA 3270, BSC 3270, BSCRJE, the interconnecting network route selector (IR), X.25, and OSI (Open Systems Interconnection) protocols. By means of the Sunlink 3270, one can interactively access applications software running on IBM hosts, which machines use either the SNA or BSC communications protocol.

The Huasheng 3000 workstations have a graphics development environment that integrates such functions as graphics standards, advanced windowing systems, network file system access, and high-speed graphics pipeline hardware. Sun Core is the software for the SIGGRAPH graphics standard, and Sun GKS is the software for the GKS graphics standard.

The Huasheng 3000 workstations are highly reliable, with a mean time between failure of 2,000 hours and more. It is quite compatible with the Sun 3/100, completely compatible at the object-code level, and it has a high performance-to-cost ratio (price is about 25 percent lower than for similar products from foreign firms).

III. The Situation for Applications of Workstations in China

Use of workstations in China has now begun, and many colleges, institutes, design academies, and factories are using various workstations. The Apollo workstation came into China first, and has captured a significant market share domestically. Later, the Sun workstations, VAX workstations from the DEC Company, and Hewlett-Packard workstations made similar inroads.

More than 20 universities are currently using Apollo workstations, as for example Qinghua and Shanghai Jiaotong. Among institutes are: the Institute of Shipping Technology, the Beijing Institute of Special Electromechanics, the Computing Institute and Physics Institute of CAS, the Wuhan Institute of Computer Peripherals, the Shanghai Institute of Electrical Appliances, the Ministry of Geology and Mineral Resources' Institute of Petroleum and Mineral Exploration, the China Institute of Precision Aviation Machinery, the main academy of the Beijing Iron and Steel Design Institute, CAS' Software Institute, the East China Computing Institute, the Shanghai Internal-Combustion Engine Institute, the Beijing Institute of Heavy Shipping Machinery, and the Changzhou Semiconductor Institute. Among plants are: the Ministry of Aeronautics and Astronautics Industry's North China Machinery Plant, the Shenzhen Precision Die Plant, the Xinxing Instrument Plant, the Shenzhen Wanyuan Electrical Appliance Equipment Company, the Shanghai Aircraft Plant, and the Shanghai Computer Plant. From these units, one can see something of the situation in China regarding use of the Apollo workstations. Domestic applications software development units have also come up with many software products for the Apollo workstations, all of which include Chinese-character capabilities. Such software includes that for: electronic design and PCB [printed circuit board] layout, gate-array design, die design and production, engineering design, pipe design, civil construction design, and satellite image analysis systems.

There is even more use of DEC's VAX workstations in China. For example, the Offshore Oil Exploration Developmental Research Center of the China National Offshore Oil Corporation has imported VAX 8650, 8550, MicroVAX II, and VAX Station 2000 workstations for use in petroleum and natural-gas exploration. CAS' High-Energy Institute has imported a VAX 6330, 10 VAX Station 3100 workstations, and one DEC Station 3100 workstation for use in the Beijing Electron-Positron Collider project. This system incorporates 13 VAX computers and 15 workstations to form a powerful multiple-computer data processing system. The Beijing University Audio-Visual Information Processing Laboratory is a key national laboratory, and it has VAX Station II/GPX workstations and Sun workstations used in image-processing systems. CAS' Science and Technology University is using a VAX 6300 for zone control, while a large VAX cluster is used for overall control; VAX 8700 and VAX Station 2000 workstations are available on the university network.

In summary, because the processing capabilities, storage capacities, and graphics functions of workstations are so much more powerful than those of personal computers, and since the costs are significantly less than for minicomputers, workstations are quite suited to China's computer applications. In China, that the workstation has rapidly come into use just proves that point. To better disseminate the application of workstations, we should pay attention to such efforts in applications software as Chinese-character capability, porting, and development. Applications of workstations in China at present have only begun, and future areas of application will broaden and the number of different types of machines used will increase.

Radar Antenna Parameter Testing System Developed

90CF0083D Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 37, 27 Sep 89 p 28

[Unattributed article: "Radar Antenna Parameter Testing System"]

[Text] During the development process of equipment for radar and radio communications, the measurement of antenna parameters is a very important task. In recent years, there has been great development of low-minor-lobe antennas and extremely-low-minor-lobe antennas; for these antennas, conventional far-field testing is difficult to accomplish because of limitations in conditions at reception areas or in instrumentation. Institute No 14 of the Ministry of Machine-Building and Electronics Industry has used near-field testing techniques with its successfully developed low-minor-lobe antenna-surface near-field testing system. Effectively and conveniently accomplishing the task of testing, the institute has in the process overcome the difficulties of far-field testing.

This system is largely made up of a Great Wall 0520CH microcomputer, probes, a network analyzer, printer, and plotter. The system software has such features as control of probe movement, sampling of the aperture of the antenna under test, calculation of the electrical parameters of the antenna, plotting and printing, and self-checking and management. The system's precision positioning scanner that can control shifts in the X and Y axes has an effective range of 1.2 meters x 1.2 meters, and within that 1.2-meter-square surface area, random error along the Z axis is less than or equal to 0.0153 mm (RMS), and after amplitude and phase sampling of the antenna aperture, the computer can calculate 2- and 3-dimensional lobes.

When test results from this system on a 0.7-meter plate antenna are compared with those from far-field testing, the far-field lobe derived from the near-field is coincident with the measured far-field lobe, and in places where levels are -30 dB in the minor-lobe regions, the differences between the two are less than 1 dB.

New Laws To Ban Copying

40100022B Beijing CHINA DAILY (Business Weekly) in English 8 Jan 90 p 4

[Text] To facilitate a burst of growth in China's computer industry, law-makers are working hard on the country's first computer software protection regulations. They are scheduled to put the rules into effect early this year.

The regulations will include articles banning the illegal copying and selling of the software invented by foreigners, other Chinese businesses and experts.

The drafting of the regulations, started in 1986, has just been finished. The rules have been submitted to the State Council for approval, said Wang Qinsheng, an official of the Ministry of Machinery and Electronics Industries. Wang expects approval within three months.

Declining to provide detailed information about the regulations, Wang said they are similar to most foreign countries' copyright laws.

According to the regulations, all software sold in China will have to be registered. Otherwise those who create the software will not have the right to sue those who copy it.

Only a few kinds of foreign software are registered in China, although illegal copying is serious in China at present because the country doesn't have a software protection law.

Wang said the regulations will be the first step in offering legal protection and completes the preparatory work for the final drafting of the software copyright law.

A general copyright law has been submitted to an ongoing National People's Congress session for review. BUSINESS WEEKLY learned that computer software protection is also included in the draft law, but it is not known when the law will be approved.

The regulations are expected to have great impact on stirring the initiative of researchers and promoting the development of the Chinese software industry, Wang said.

Li Ye, head of the ministry's computer bureau, said a takeoff by the Chinese software industry would not happen without such protection regulations.

He said that many researchers have worked very hard to develop software, hoping to sell it for a good profit. But very often they find that their programmes have already been copied by others and sold at cheaper prices.

"Without the money, they can't even make up their losses during research," Li said. Yet they lack the ability to bring the plagiarizers to court.

This makes the situation worse for the slowly-progressing software industry in China, which is already far behind the world level.

There are only about 35,000 people working in the software industry in China, while the figure in the United States is close to 1 million. This is in spite of the fact that China has more than 1.1 billion people and the United States has only about 200 million.

Li said that during the Eighth Five-Year-Plan (1991-95), China hopes its annual output value of software will reach $268 million and about $50 million worth of the products is set to be exported every year.

"In order to fulfill such a goal, it is urgent to start protecting software development," Li said.

Neural-Net Image Associative Memory Using Optical Threshold Feedback

90CF0040 Beijing KEXUE TONGBAO in Chinese Vol 34 No 13, Jul 89 pp 984-986

[Article by Mu Guoguang [3018 0948 0342], Wang Xuming [3769 6079 2494], and Zhang Yanxin [1728 1693 3512] of the Institute of Modern Optics, Nankai University, Tianjin: "Two-Dimensional-Image Associative Memory Using Optoelectronic Hybrid Threshold Feedback"; manuscript received 12 Nov 88]

[Text] Keywords: neural network, Hopfield model, associative memory, optoelectronic hybrid

Associative information storage and recovery are recognized as the basis for parallel calculation and brain memory, as well as for the recognition function. Because of such features of optical calculation as speed, high capacity, parallelism, and spatial connectivity, since Hopfield introduced the associative memory model in 1982,[1] optical information processing modeled on neural networks has attracted a great deal of interest. Optical neural networks can simulate certain functions of the brain, as for example with the addressing function for the full recovery of the content of an undistorted image using partial or distorted data. There are currently two models: the first is an external product based on a vector-memory matrix, and the other is an internal product based on a vector-vector arrangement.

The external model is more difficult when it comes to handling large volumes of pixels, and especially for 2-dimensional images, where the memory matrix that is involved is a 4-dimensional tensor; this means that the processing will be quite difficult, whether an electronic method is used or an optical method.[2] Reordering a 4-dimensional tensor into a 2-dimensional form allows realization through an optical method, but this can only be achieved when there are small quantities of pixels (as for example with 4x4 2-dimensional images); when processing large quantities of image elements, it is difficult to achieve this kind of 2-dimensional form.

Using the internal model involves only vector-vector calculations.[3] As long as the 2-dimensional image is seen as 1-dimensional vectors arranged in two dimensions, the image-image product is the internal product of the vector, and this kind of operation can be easily done with an optical method. In this paper, we propose a 2-dimensional-image associative memory technique that is based upon the internal product model, an optical circuit diagram for which is shown in Figure 1. It uses a single holographic image as its memory and connective device to realize the necessary product and summation function. The CCD [charge-coupled device] array receiver will output the image, transforming it into visible electronic signals, then will output the image sample threshold value in the threshold circuit using an electronic method. The electronic threshold processing line under computer control can be regulated, which enables the ordering of the threshold processing, and also provides an optomechanical interface. The threshold-processed signal is sent to a liquid-crystal television (LCTV), and with feedback in image form it then reenters the circuit to complete the cyclical iteration.

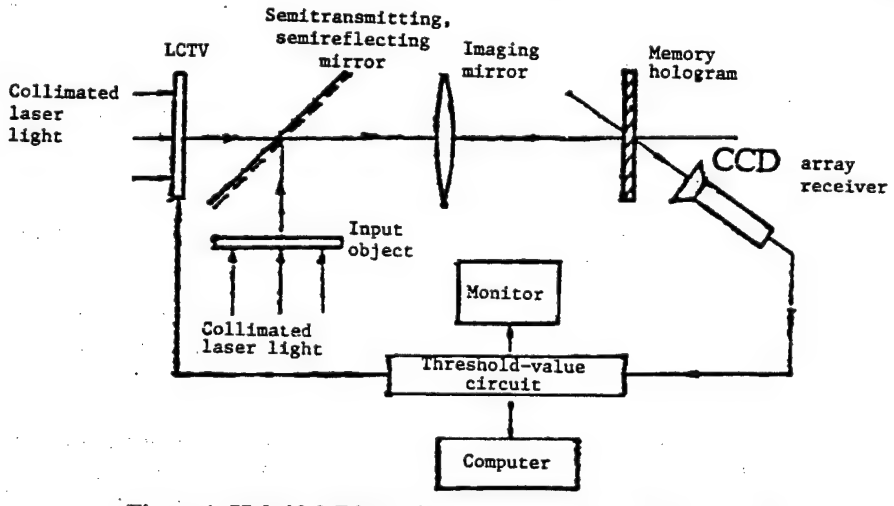

Figure 1. Hybrid 2-Dimensional-Image Associative Memory

The memory hologram is pre-stored with several images, and multiple holographic records involve multiple exposures to photoconductive dielectric, where on each occasion two beams are used from the coherent light wave A_i, B_i (where i = 1, 2, ..., n is the exposure ordinal number) of the related objects a_i and b_i. When the hologram reflects the multiple beam field A'_m, then A'_m is a distortion of A_m or its localization, and the spectral amplitude after passing through this multiple hologram can be represented as

$$A'_m \sum_{i=1}^{n} |A_i + B_i|^2 \sim A'_m \sum_{i=1}^{n} A_i^* B_i$$

$$= A'_m A_m^* B_m + \sum_{\substack{i=1 \\ i \neq m}}^{n} A'_m A_i^* B_i.$$

From the surface of the holographic rendition, we obtain:

$$\{A'_m \cdot A_m^*\} b_m + \sum_{\substack{i=1 \\ i \neq m}}^{n} \{A'_m \cdot A_i^*\} b_i,$$

where * represents the conjugate, and unordered set:a x b represents the internal product of a and b.

When generating holograms, the amplitude distribution of the light wave B_i that is generated by the natural photographic field b_i on the holographic recording surface is uniform, and so every point in the hologram (within the effective range of A_i) is equivalent to the weight of the recurring b_i. If A_i is simply a_i itself, then the degree of brightness of the b_i recurring image may be completely derived from the size of the internal product of a'_m and a_i, that is, the output result is

$$\{a'_m \cdot a_m^*\} b_m + \sum_{\substack{i=1 \\ i \neq m}}^{n} \{a'_m \cdot a_i^*\} b_i,$$

This recurring image includes the weighted sums of all possible images b_i, and although the weight of b_m is greatest, the differentiating capacity is deficient. To better reproduce b_m that are closely connected with a'_m, we must suppress all other intersecting images, while retaining or strengthening only the unordered set: a'_m x a_m b_m. Threshold processing can attain this goal, enhancing b_m reproduction and improving the differentiating capacity of the system. If a_i and b_i represent the same object, then the output result will be the derived threshold results of the weighted sums of the entire images of all instances of a_i:

$$N.\ L.\left|\{a'_m \cdot a_m^*\} a_m + \sum_{\substack{i=1 \\ i \neq m}}^{n} \{a'_m \cdot a_i^*\} a_i\right|,$$

where a_m is enhanced, the reproductivity of the feedback image enters calculations for iteration, and finally, a_m is reproduced, while other images are suppressed.

We have used two images to display the associative reproduction of this kind of multiple image, selecting the two Chinese-character phrases "Tianjin" and "guangming" for double-exposure holographic recording. The two completely identical images are each done as two-beam optical input, and after the image within the reference beam forms on the holographic recording surface, the image in the object beam forms near the recording surface.

Figures 2 through 4 [not reproduced] show experimental output results. It can be seen that when a partial image is input (as for example that shown in Figure 2), the function of the feedback loop circuit is rather more obvious, and inclusion of the feedback improves and strengthens the reproduced output image. And when the regulated amplitude image is used as input, the feedback-loop circuit conversely has no gain (as shown in Figure 3). This kind of distortion cannot be attributed to a theoretical deficiency, but rather arises from the real-time device used in this experiment—the imperfect optical quality of the LCTV device. When the CCD array receiver gets the reproduced signal, the circuit threshold value and the feedback might be perfect, but because the LCTV cannot truly reflect the feedback image (typical values for proportion are only from 2/1 to 4/1), this causes the actual feedback image to equal one to which yet another background has been added. When a partial image is used as input, the associated reproduced image has more information than does the input image. Although image quality for the LCTV declines during feedback, generally speaking, that is an information enhancing process. And when the regulated amplitude image is input, it contains all information of the image awaiting recovery, the amount of feedback image information at best can only be the same as the input image, and LCTV can still not achieve that point, which leads to the distortion of the output image. For this reason, finding real-time feedback components having excellent optical performance is one key to the application of optical neural networks. Figure 4 shows the associative reproduction result of another image.

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Computer Industry Plans To Expand

40100022A Beijing CHINA DAILY (Business Weekly) in English 8 Jan 90 p 4

[Text] The 1990s are a decade of ambition for China's computer industry. Expansion plans are being drafted to promote massive production and export sales.

At the heart of the planning is the state-of-the-art fourth generation of computers to be developed during the Eighth Five-Year Plan (1991-95).

"An integrated computer industry will be important to China's national economy and defence," said Wang Qinsheng, an official of the Ministry of Machinery and Electronics Industries.

The planning, she said, falls into three main categories.

Mass Production

Starting this year, China will choose to foster only large- and medium-sized computer enterprises as the vanguard of the industry's advancement. Wang said the State will give them priority treatment, such as providing development loans for operating capital.

She said these enterprises will include the Great Wall Computer Corporation and the Chang Jiang Computer Group Company.

These enterprises turn out more than 75 per cent of the nation's computers and software.

"If we can guarantee the development of these enterprises, the computer industry will be stable," said Guo Chengzhong, deputy director of the ministry's computer bureau.

As for computer manufacturers with production capacity under 500 a year, he said, the country will curtail their expansion while asking them to concentrate on developing new products and popularizing their existing products.

As part of China's readjustment of its industrial structure, Guo said, the ministry will stress the development of microcomputers, minicomputers and software.

Guo said that sales of the small computers are increasing. One microcomputer series accounts for 50 per cent of the domestic market for computers.

"Demand for portable microcomputers is also expected to be on the rise," he said.

Expanding Exports

During the 1991-95 period, the country is planning to set up three computer production bases for export in Guangdong and Fujian provinces, the Yangtze River Delta and the Bohai Bay area.

About 900 million yuan will be invested in the existing producers in those areas to expand their production capacity and improve the quality of their products.

"At least 10 firms in each of those areas will be chosen to enjoy the ministry's preferential treatment," Wang said.

Foreign investment and Sino-foreign joint ventures are encouraged in these areas, she said.

The base in Guangdong and Fujian provinces will concentrate on the production of spare parts, including circuit boards and magnetic heads.

The Yangtze River Delta operation will focus on the development of computer systems and software, while the Bohai Bay unit will develop all aspects.

"China will have to export computers so that the industry can survive and prosper," Wang said.

The country's estimated $150 million worth of computer exports is far from enough to serve the purpose, she said.

The country is capable of producing 300,000 computers this year, but the domestic market only needs 100,000. The national annual computer production capacity will exceed 1 million by 1995, experts predicted, but total computer sales will only be around 500,000.

At present, more than 100 Chinese computer factories, equipped with imported production lines, are already waiting for orders.

China's computer industry is, in general, technologically backward. Whole sets of computers are not likely to see a large export increase in the future because of the competition in the world market, Wang said.

Therefore, the ministry's new export strategy will be expanding sales of computer spare parts, including circuit boards and magnetic heads for the foreign market.

China is estimated to be the top seller of computer magnetic heads this year, although specific sales statistics were not available.

Popularizing Computers

Guo said China is determined to develop new products in many key areas. By doing so, it aims to help the domestic computer industry to take more of the national market from the grasp of foreign computer sellers.

The popularization drive will first concentrate on providing specialized software for the country's power, metallurgical and machinery industries and transportation agriculture and education areas, Guo said.

He said that China will also reduce importing and block the smuggling of computers. The country will check illegal sales of import licences for computers.

At the present, Chinese-made micro-computers and minicomputers only account for 60 per cent of the total domestic market.

"If the share is raised to 80 per cent, it means that about 20,000 more Chinese-made computers will be sold," Guo said.

Difficult But Promising

Despite its ambitious plans and the fast development of the computer industry in recent years (the annual growth

rate has been 30 per cent), the foundation beneath Chinese manufacturers is not firm.

Most of the large- and medium-sized computers needed on the domestic market have to rely on imports, but because of the industry's limited connection with the world market, it has not set up a mechanism for responding to the latest computer developments around the world.

Also, production costs are expected to keep rising as prices for some imported integrated circuits and raw mateirals are soaring both at home and abroad.

Developments in Robotics Reported

Robot Developed With Four Degrees of Freedom

90CF0084 Tianjin ZHONGGUO JISHU SHICHANG BAO [CHINA TECHNOLOGY MARKET NEWS] in Chinese 14 Jun 89 p 2

[Article by Wei Jiefen [7279 2638 5358]: "Elementary Intelligent Robot"]

[Text] A high-precision assembly robot with four degrees of freedom and hand clutching and release functions, developed by the Robotics Institute of the Hangzhou Academy of Electronics Industry, can accurately and flexibly pick up components, then move to the point of assembly for installation and assembly. The accuracy for repeated positioning is plus over minus 0.02 mm, which is suitable for the assembly of precision components. The robot components, driver motors, and raw materials were all produced in China, it has a high performance-to-cost ratio, it is convenient for arranging production and for dissemination and application, and it also can be used for painting and soldering operations.

The experts concluded that this robot meets technical specifications equivalent to those of a servo assembly robot made abroad during the early 1980s, and that it occupies a foremost position among domestic stepping-motor drivers and open-control assembly robots.

New Climbing Robot Unveiled

90CF0084 Beijing ZHONGGUO DIANZI BAO in Chinese 26 Sep 89 p 1

[Article by Cai Tiewen [5591 6993 2429]: "China Builds a Two-Foot Spatial Walking Robot"]

[Text] The Changsha University of Science and Technology for National Defense, originator of the Galaxy 100 MIPS [super]computer, recently announced that a new robot—a two-foot spatial walking robot—has been successfully developed there.

Based upon China's first two-foot surface walking robot, developed last year by this institution, the robot was developed after further exploration and improvements. The robot weighs 12 kg, is 64 cm tall, has 10 operating joints, can go forward and backward on a level surface, climb stairs, and can also move sideways. It is dexterous in movement, quick, and is stable as it moves. Good spatial equilibrium has been guaranteed, which more closely approaches the ways of human movement.

Aside from the motors and some components, all devices in this robot were produced in China, and all components were finished by the developers themselves. The experts judged that this robot has attained a level equivalent to that current internationally. Its appearance signifies that robotic development efforts in China have seen yet another breakthrough.

Robotic Systems Simulator Announced

90CF0084 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 38, 4 Oct 89 p 1

[Article by Xiu Ying [4423 5391]: "A New Achievement in the Field of Intelligent Robotics"]

[Text] The robotics system simulator level-one system ROBSM1, developed by the Qinghua University Computer Department, recently passed its technical evaluation. The evaluation committee was jointly chaired by the State S&T Commission High-Technology Department, the State High-Technology Automation Field Specialists Commission, and the '863 Plan' Expert Group for the Intelligent Robot Project.

This simulation system can be used for simulation of kinematics, dynamics, course planning, and control systems for the Puma 560 and robots of similar structure. This system provides a convenient interface, useful by customers for full analytical study and comparison of various control and planning algorithms for the robots.

The system takes into consideration many such real factors as friction, model error, and calculating delays, which then allows the simulation system to more closely approximate vacuum conditions. The system can also provide a flexible and convenient interactive environment, as input can be by file, terminal prompts, and default, and a help program can aid the user in modifying the parameters. Output can be by data and by graphs, which can then be displayed on a terminal and can also be printed out, and the system is implemented through a multiple-level menu environment that can be mouse controlled, and which is quite flexible in use.

The successful development of the simulation system provides a convenient tool for research and design of robotics systems, and it provides an effective supplementary means for the teaching of robotics. The appraisal committee concluded that the principle functions of this simulation system are at the advanced level of similar foreign systems.

It has been said that on the basis of developing this first-level system, this university is currently engaged in development of a second-level system, which adds to this first-level system such functions as language input and graphics displays.

High-Powered Tuneable Neodymium Glass Laser Developed

Beijing CHINA DAILY in English 19 Jan 90 p 3

[Text] The Chinese University of Science and Technology has developed the first new 10,000-megawatt tuneable neodymium glass laser device in the world, the overseas edition of the PEOPLE'S DAILY reports.

The equipment, using the feature of neodymium glass with a wider gain band, makes the laser wavelength continuous and tuneable in the gain band.

The device was designed and installed by the physics department of the university. All parts and electronics, except a high-speed switch, were made in China.

The device will contribute to the study of the multi-photon ionization process of atoms and electrons, X-ray laser mechanisms, plasma X-ray microscopy, plasma spectroscopy, and features of materials subject to ultra-high voltages and temperatures.

The new device has been developed by Dai Yusheng, Wang Shengbo, Wu Hongxing, and Guo Dahao, who were the major research scientists.

New Satellite Communications Equipment Unveiled

Chengdu Earth-Station Equipment Certified

40080006 Beijing ZHONGGUO DIANZI BAO in Chinese 25 Jul 89 p 1

[Article by Duan Yixing [3008 1355 5281]: "High-Effect Equipment for Chengdu Satellite Communications Earth Station Passes Acceptance Check"]

[Summary] High-effect equipment for the Chengdu Satellite Communications Earth Station recently passed check-upon-delivery at the China Zhenhua Electronic Industries Corporation's Changhong [7022 4767] Machinery Plant. This equipment, manufactured at the Changhong Plant, is superior in structure, circuitry, and digital video display technology to the high-effect equipment produced last year [i.e., 1988] by the plant for the Yunnan Satellite Television Uplink Station.

The high-voltage stabilization circuit in the continuously variable transformer has a magnetic-saturation voltage regulator/stabilizer. The new equipment also has a high-accuracy, broad-range power-stabilization circuit. Audible noise is less than 64dB and microwave radiation is far lower than the Imv/cm^2 [?1 milliwatt per square centimeter] standard. Operation is automatic or manual, with provision for remote control and for automatic exchange of the main and back-up units.

First C-Band Microstrip Satellite TVRO Antenna Developed

40080006 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 8 Nov 89 p 1

[Unattributed article: "China Develops New TV Receiving Antenna; Can Directly Receive the Three Channels of Satellite-Transmitted Central Television Programs"]

[Summary] After a one-year-plus effort, the Chinese Academy of Sciences' (CAS) Shaanxi Observatory at Xidian University [formerly Northwest Institute of Telecommunications Engineering], Institute 771 of the Ministry of Aeronautics and Astronautics Industry, and Jiangsu [Province's] Taixing [3141 5281] Microwave Components Plant have jointly developed China's first C-band (4000MHz) TV-reception microstrip antenna. This antenna can directly pick up the three channels of [China] Central Television programs relayed by China's operational communications satellites. The received images are ideal.

The microstrip antenna, also called a printed-circuit antenna or plate aerial, is a new kind of antenna. Current C-band satellite TV receivers worldwide use 3-meter parabolic antennas, which are bulky, costly to manufacture, and difficult to install. Beginning in June 1986, the Shaanxi Observatory and its affiliated units analyzed parameters of downlink data from China's operational communications satellites and proceeded to develop a small-sized, lightweight, low-cost satellite ground-station microstrip antenna. This antenna, which has proven highly effective over 16 months of testing, has a 1.8-meter-by-1.8-meter square planar structure. Utilizing one such antenna, which contains over 1000 micro-antennas, television viewers can receive Central TV channels 1 and 2, which are relayed via China's communications satellites, as well as the public-wavelength TV channel from Xinjiang and Yunnan. Images are sharp, color is natural, and sound is lifelike.

Warship Electronic Technology in Development

90CF0138A Shanghai CHUANBO GONGCHENG in Chinese No 5, 1 Oct 89 p 39-43

[Article by Yan Junxing [0917 0193 2502] of the Electronic Technology Academic Committee]

[Text] Electronic technology is a young and growing field; it is continuously generating different new branches and no one can predict what the final development results will be. In this article we can only give some prospects based on the current situation and the development process in the last 40 years. Warship electronic technology involves a number of topics and in the limited space here we can only describe some selected major topics.

Future development of warship electronics will be centered around two major topics: the design of the integrated command system of the ship, and the electromagnetic compatibility, technical structure and reliability of ship electronics.

In addition to C^{3}I [command/control/communication information] technologies, a ship-wide integrated command system also requires the development of a number of other systems. These include warning radar, identification friend or foe (IFF) devices, radar surveillance receivers, sonar, radio communications, data chaining, targeting radar, guided-missile attack radar, guided-missile radiation-tracking radar, opto-electronic devices, computers, directors and sea/air missile systems, main gun and auxiliary gun systems, anti-submarine rocket and torpedo systems, helicopter guidance systems, shipboard takeoff and landing systems, electronic warfare systems, and navigation systems. These systems should be interactively integrated to form a ship-wide command system.

As ship electronic systems and their degree of integration increase, electromagnetic compatibility, engineering structure and reliability become important problems. If these problems are not solved, the normal operation of the electronic systems will be impaired and the integrated control and command will be jeopardized.

I. Warship integrated command & control system

In order to properly design a warship integrated command and control system, there are three tasks that must be completed:

1. Research and development of C^{3}I technologies

China began its research of warship C^3I systems in the late 1960's. First-generation research prototypes and first-generation C^3I systems were tested, evaluated, and installed on ships for usage. Valuable experience was obtained from the usage of these units. The next step is to develop more advanced C^3I systems; to this end we must:

(1) develop multi-microcomputer distributed C^3I systems;

(2) adopt standardized data buses and develop medium- and high-speed data buses;

(3) develop fault-tolerant computer technology and apply it in multi-microcomputer distributed systems in order to improve the reliability of the computer system,

(4) develop fiber-optic technology for data transmission and for resistance against electromagnetic interference,

(5) develop layered and modularized software, properly choose program-design languages and promote the Ada language,

(6) develop distributed naval-warfare command-system data bases and management systems,

(7) develop large-screen displays and liquid-crystal plasma displays,

(8) develop ergonomic engineering of interface and display terminals and formulate their standards,

(9) further improve data-chaining techniques, especially data-chaining systems between the troops and the shore,

(10) research and develop target simulators and warfare-environment simulators.

2. Development of new radars, IFF devices, radar surveillance receivers, sonar, radio communications, intraship communications and various opto-electronic devices

China has independently developed its own second-generation electronic equipment with greatly improved performance; however, these pieces of equipment were developed based on a design approach of individually controlled single machines and separately controlled systems. The equipment was rarely integrated with computers and could not satisfy the integrated control of ship-wide communications. In the future development of electronic equipment, the design must be capable of integrated command of the whole ship and the devices should be viewed as transducers of a C^3I system. The devices must be able to provide high-quality signals to the C^3I system for automated computer processing, and the electronic devices must be fast, compatible and resistant to electromagnetic interference.

(1) Radar

Radars can be divided into warning radar, targeting radar for guns, guided-missile attack radar, and navigational radar. The warning radar is the main signal source for a C^3I system. Radar transmits a large amount of signals from the sea and the air, and therefore requires high-speed data processing and sophisticated signal-evaluation techniques. The quality of the radar signals directly affects the performance of the C^3I system. It is necessary to develop constant false-alarm rate (CFAR) technology, digital moving-target technology, signal-locus processing technology, digital data-processing technology, beam-control technology, frequency agility and adaptive technology, and the problems of overhead and low-altitude blind zones. In addition, to meet the need of large ships to be built in the future, the development of phased array radars on ships should also begin.

In the development of targeting radar for guns, the search/capture diagram of the beam should be properly designed in order to improve the automatic capture speed and the capture probability. The angular tracking speed and acceleration should be increased. The multiple-path problem should be solved for ultra-low-altitude tracking. Calibration techniques for sea and air radar should be developed. Pulsed Doppler systems and frequency-agility and adaptive techniques must be perfected. Laser, infrared and television devices should be installed on the antenna frame of radars in order to improve the resistance to electromagnetic interference.

All radars must incorporate computer technology in order to achieve frequency agility, adaptive response, and resistance to interference, as well as to implement beam-control, signal-processing, display-terminal, and digital data-transmission techniques.

(2) IFF devices

In designing new IFF devices, attention should be paid to solving the digitization problem. Digitized coding and decoding should be used to enhance security and guard against enemy decoding attempts. Other advantages of digital codes are automation, high speed, and accuracy in decoding and display and multichannel control.

(3) Radar surveillance receivers

Gallium arsenide FET's should be used to replace the present low-noise traveling wave tubes in order to improve receiver sensitivity. To achieve a transient bandwidth greater than 1 GHz, surface-acoustic-wave (SAW) delay lines or wideband delay lines using fiber-optic means and opto-electronic processing techniques should be used. Parallel processing technology should be used to realize a 100-percent intercept-and capture probability and 100-ns capture pulse width fast-response ability. In addition, the surveillance and interference bands should be extended into the millimeter-waveband. A data base of enemy radar parameters should be established to provide the C^3I system with the means to identify enemy ships and aircraft.

As part of the electronic-warfare systems, an interfering radar should search for the effective interfering mode based on the beam-tracking method, the frequency-agility speed and adaptive techniques. Major projects

needing research are systems to jam the [enemy's] targeting radar, radiation-tracking radar, and terminal-guidance radar. In order for one interfering radar to jam many radars, phased-array interference antennae must be developed and high-speed surveillance and frequency agility must be studied.

With regard to the development of stealth technology, the effective radar cross section (RCS) of a ship must be kept to a minimum.

(4) Sonar

Sonars can be divided into active sonar, passive sonar, sonar buoys, hanging sonar, towed sonar, underwater communications sonar and so on. When sonars are integrated into the C^3I system for ship-wide communications control, there are a number of problems, including limited range of action, the signal instability, difficulties with automated processing, and problems with eliminating working-frequency conduction interference and with computerization.

(5) Communications

Communications includes radio communications, data chaining, and intra-ship communications. Radio communications can be further divided into UHF communications, HF communications, satellite communications, and ultra-long-wavelength communication. In each of the radio communications methods attention is to be given to security, speed, accuracy, anti-jamming ability, reliability and electromagnetic compatibility.

In the future development of radio communications, the stress should be on warship integrated communications systems. In such systems, a computer is used to carry out time-division program control according to a stored frequency table. The multiple high-frequency communications networks used in the past are to be replaced by a high-frequency, high-speed frequency-changing transmission system consisting of a broadband transmitter and a broadband antenna. This will alleviate the crowdedness of the superstructures and improve the electromagnetic environment. In addition, research should be done on adaptive frequency selectors, adaptive modems, adaptive antenna arrays, and adaptive interference-canceling techniques. Also to be studied are error-correcting techniques including convolutional codes and packet codes; electronic countermeasures against interception and capture, eavesdropping, and code-breaking such as burst communications, spread-spectrum communications, adaptive null-adjustment antennae, and integrated command and control communications; and modern electronic cryptological techniques such as speech-simulation [i.e., artificial-voice] cryptography, sequential code systems (a high priority for research), packet encryption systems and public code systems.

In the area of data chaining, research should be done on ship-to-ship, ship-to-air, and ship-to-shore tactical data chaining. Work should also be done on ship integrated-services local-area networks (SISLN) that combine voice, data (telegraph electronic text, tactical data, graphical data, and intelligence information) and graphics (both static and dynamic).

All-digital stored-program-controlled (SPC) electronic exchanges and fiber-optic-cable double-bus transmission system should be developed for intra-ship voice communications.

3. Develop new shipborne fire-control and aircraft guidance and landing systems

Systems in this area include short-range anti-missile systems, integrated missile/gun fire control, ship-to-air guided missile systems, over-the-horizon ship-to-ship projectile attack systems, aircraft takeoff/landing systems, helicopter guidance systems, modern electronic warfare systems, anti-submarine systems, and integrated navigation and position-fixing systems. Some of the systems are newly developed and others are second-generation systems. Whether the systems are first-generation or second-generation, the subsystems must be designed to form an integrated command and control system for the ship. The following three requirements should be satisfied:

(1) Sensing devices on ship should be as few as possible and the common signal sources should be shared in order to reduce the crowded condition of the superstructure space and electromagnetic interference. We are against the small, closed complete systems used in the past.

(2) Computers (directors) of subsystems should be standardized in model, data format, data bus, and programming language. They should be compatible with the C^3I system.

(3) The range of power, accuracy indicators, transmission parameters and feedback signals of the various systems should all be linked up.

If the single units and systems described above are all designed according to the requirements of the ship-wide command and control system, then the ship-wide integrated control system consisting of the subsystems and the C^3I system will be closer to perfection. Hardware weapons on ships, such as guns, torpedoes, guided missiles, chaff projectiles, and antisubmarine missiles, can only be produced in a limited number of models, and they contribute to the lack of versatility in the fighting power. The electronic equipment (probes, trackers and directors) that controls the weapons, on the other hand, are very versatile. A given piece of hardware may be controlled in a number of ways and the resulting fighting power and effectiveness can be drastically different. An optimally designed ship-wide integrated control system will greatly improve the fighting ability of a ship.

II. Electromagnetic compatibility, technical structure and performance reliability of ship-born electronics

Electromagnetic compatibility, technical structure and performance reliability are the three common problems

faced by all ship-borne electronic equipment and systems. In order to investigate these problems in depth and to come up with solutions, the electronic technology committee of the China Society of Shipbuilding Engineers specifically established three specialty groups. After nine years of hard work and dozens of technical conferences, training sessions, new-technology symposia, and foreign expert lectures, the specialty groups have written and translated a number of publications. These include RECOMMENDATIONS ON WARSHIP-EQUIPMENT ELECTROMAGNETIC COMPATIBILITY, HANDBOOK FOR RELIABILITY DESIGN, SELECTED PAPERS FOR HIGH-LEVEL POLICY CONSULTATION, CODES, STANDARDS, AND REGULATIONS ON ELECTROMAGNETIC INTERFERENCE, and DESIGN HANDBOOK FOR ELECTROMAGNETIC COMPATIBILITY. These publications have played an important role in the development of this discipline.

Future efforts should concentrate on translating these goals in principle into engineering designs and actual tests and conducting future investigations of newer technologies.

1. Electromagnetic Compatibility Problem for Ship Electronics

(1) Establish regulations on electromagnetic compatibility and make them part of the military certification and inspection items. Make the designer of the system technology, the shipyard and the manufacturer of the equipment all be responsible for the electromagnetic compatibility. Make the three parties work together in solving the problem.

(i) The shipyard: The shipyard should concentrate on power-supply filtering, chamber shielding, equipment grounding, cable installation, superstructure layout, and the joining of metal rods and cables.

(ii) Single-machine plants and research institutes: These manufacturers should concentrate on filtering, rectification and voltage stabilization of the power supply on the electronic equipment, console shielding, grounding, higher-order harmonics, antenna directivity plots, anti-jamming circuit design, and isolation of oscillation sources.

(iii) Designers of system technology: These units should be responsible for the overall electromagnetic compatibility problem and do a good job in system design. They should also solve the frequency-allocation, antenna-layout, and mutual-interference problems, and work on near-field personnel safety, ignition, and detonation problems.

(2) Among the numerous pieces of electronic equipment on a ship, the interference problems of radio communications equipment and data-transmission computers should be given top priority.

In terms of frequency-band distribution, the interference problem for low-frequency sonar, underwater communications and omega receivers is mainly interference with conduction at the working frequency. Infrared equipment and lasers at the high end of the frequency scale do not really have any interference problem. UHF radars have the advantages of high power and strong directionality, and use the same antenna for transmission and reception; they are therefore unlikely to be jammed by other equipment or to interfere with other equipment. Radio communications equipment, on the other hand, operates in the intermediate-wave, short-wave, and ultrashort-wave ranges; antennae for this equipment are omnidirectional, and transmitters and receivers are separated. The fundamental wave and higher harmonics of radio messages are intermingled with telegraph, telex, radio broadcasting, and television frequencies, making interference very likely. When the electromagnetic compatibility problem of radio communications on a ship is solved, then the electromagnetic compatibility problem of the whole ship is basically solved. As stated before, the solutions are in the use of common antennae, in optimizing the antenna configuration, and in the use of pure-frequency-spectrum transmitters and broadband receivers with narrow passbands.

As computers are used more and more extensively on ships for data and information exchange, the interference problem in data transmission is becoming acute. This is because the gate voltage in digital circuits is low (usually 5 volts) and the pulses are narrow (of the order of 10 ns), making digital data transmission very vulnerable to pulse interference and switching of the 1 and 0 code states. This problem can be solved by using fiber-optic cable transmission line and anti-interference software.

(3) Research in electromagnetic compatibility should include the following:

(i) Establish regulations for electromagnetic compatibility and publicize the regulations.

(ii) Study the optimum antenna configuration on ship by conducting simulation and model experiments.

(iii) Predict electromagnetic compatibility by computer calculation and mathematical models.

(iv) Establish a data base for electromagnetic compatibility.

(v) Investigate testing equipment, testing techniques and anti-interference techniques.

(vi) Solve engineering problems and publicize the solutions.

2. Technical structure problems

Electronic equipment on ship not only has to operate in a complex electromagnetic environment, but also has to work in a harsh physical environment. It has to endure impact, vibration, wind load, high temperature, low temperature, humidity, salty fog, molds and chemicals. Its continuous operation time is also longer than that of

airborne and missile-borne electronic equipment. For these reasons, the technical structure requirements for ship electronics are rather stringent, especially those involving resistance to vibration, rusting, and corrosion. Measures must be taken to increase ventilation and heat dissipation, cooling, wind resistance, water-proofing, reinforcement, and vibration reduction. Even the design of the console should take into account convenience of maintenance, cable installation, and operation, and the uniformity on the ship. Much needs to be done.

3. Performance reliability

In the design of the first-generation and second-generation products, the main considerations were placed on the questions of whether the equipment could be installed and whether it could meet the target requirements; reliability was ignored. In fact, reliability, technical performance, and economic indicators are the three main factors in judging a product's quality. Reliability is intimately related to and interacts with engineering techniques. In order to have engineering reliability, the whole process including product idea, technical design, plant production, final inspection, and usage by the customer must be considered. Reliability touches upon the quality of the raw materials and elements, design plans for the machines and systems, operating environment of the machines and operation and maintenance by the users. Of course, a good design is the key to reliability.

The following should be pursued for better reliability in sharp electronics:

(i) Fundamental and theoretical research on reliability should be carried out. This includes developing mathematical analysis methods for serviceable and nonserviceable systems; studying the establishment of reliability indexes for products and systems and methods for distribution, inspection and certification; analyzing and investigating technical problems that affect the reliability indexes of products and systems; experimentally testing the reliability of products and systems in environmental simulation test beds; and establishing reliability data bases and reliability regulations.

(ii) In designing ship-wide integrated command and control systems and fire-control systems, there should be spare designs and reserve channels. Bottlenecks in various channels should be designed with high reliability. The designs of the systems should be simplified without compromising the tactical performance. Data transfer steps and the number of components should be kept a minimum. Distributed designs meeting the reliability index must be achieved step by step.

(iii) In the design and manufacture of electronic equipment, there should be reduced-volume design, simplified design, spare design, triple-proofing [moisture proofing, salt-spray proofing, and fungus proofing] design, thermal design, vibration-reduction and impact-resistance design, electromagnetic-compatibility design, and ergonomic design. Components should be screened to weed out aging units, integrated components and high-reliability components should be used often, and tunable components and switches with mechanical contacts should be avoided. The designs should use micropower circuits, stabilized circuits, power-limited circuits, and insulated short-proof circuits. The equipment should also have means for heat dissipation, ventilation and cooling.

(iv) Digital circuit designs should be modularized and have self-testing routines and malfunction diagnostic procedures. The design should be able to tolerate certain errors, and the software should be designed to be reliable.

(v) In engineering management, reliability practices should be implemented from organizational and budgetary approaches.

Electromagnetic compatibility, sound technical structure and reliability essentially improve the service life of electronic products, consolidate the electromagnetic environment on the ship, and allow the electronics to perform efficiently in the integrated command and control system of the ship. They insure the integrated command system a longer life, higher reliability and better performance.